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Thermal Capture Cross Section determination of ^{241}Am using the FRM-II Cold Neutron Beam

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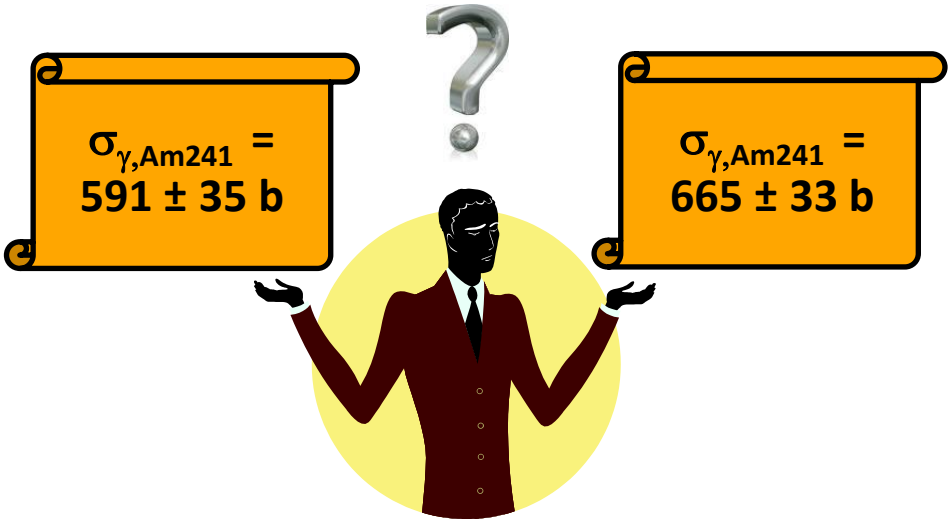
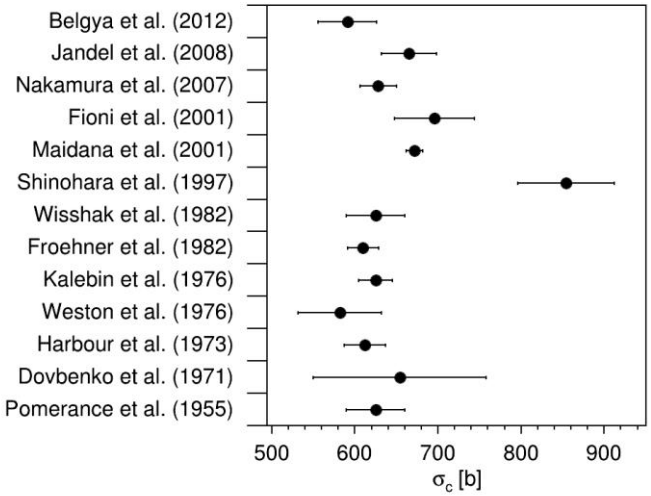
Tabulated Cross Section Data

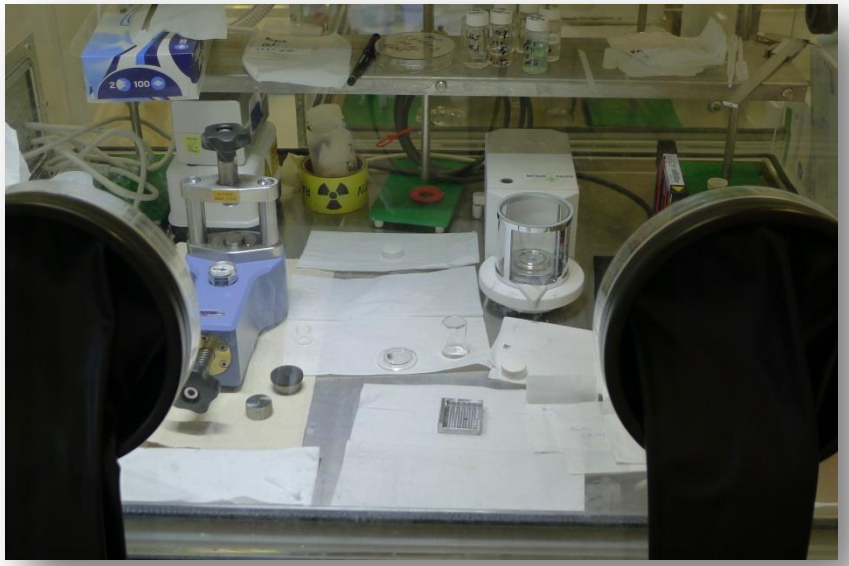


Neutron Capture Data of Minor Actinides are inconsistent

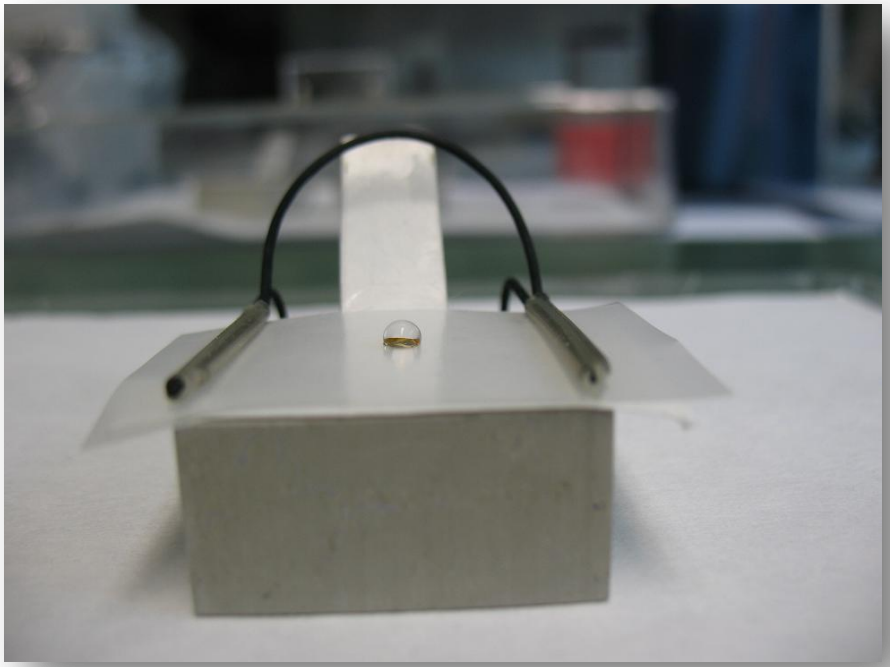


Sample Preparation

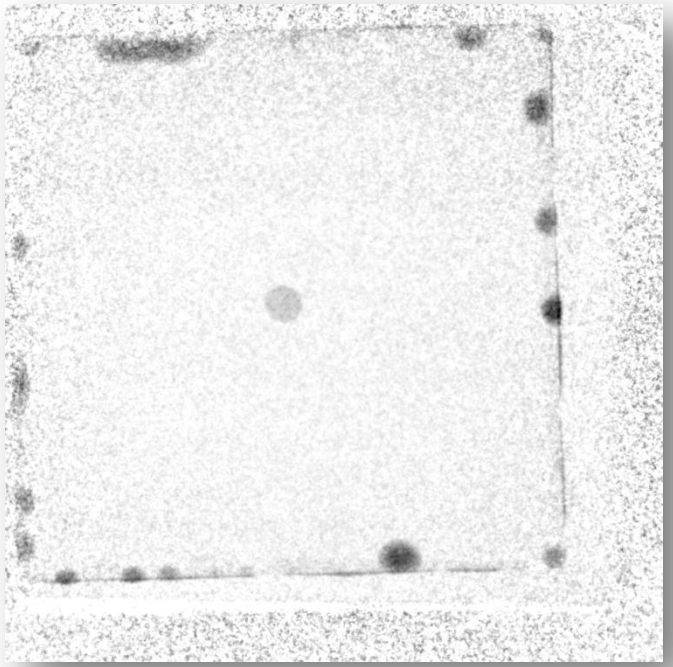
- Safe containment for actinides
- Transparency for neutrons
- Transparency for photons
- Avoid elements that change the neutron beams temperature
- As few elements as possible to reduce interference



^{241}Am sample



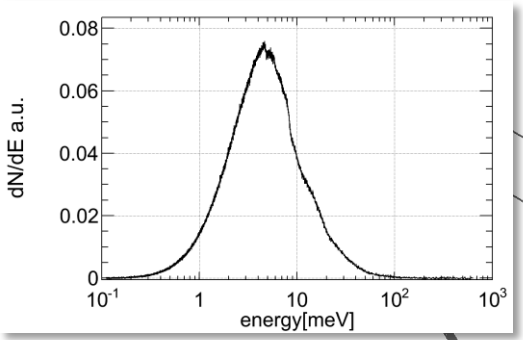
Preparation of ^{241}Am nitrate sample. A 12µl dropplet of solution is dried on the surface of a thin gold foil.



Radiographic image of most massive $^{237}NpO_2$ and gold sample.

Samples can be regarded as thin!

PGAA facility at FRM-II



HPGe detector

Compton suppressor
BGO

Lead collimator

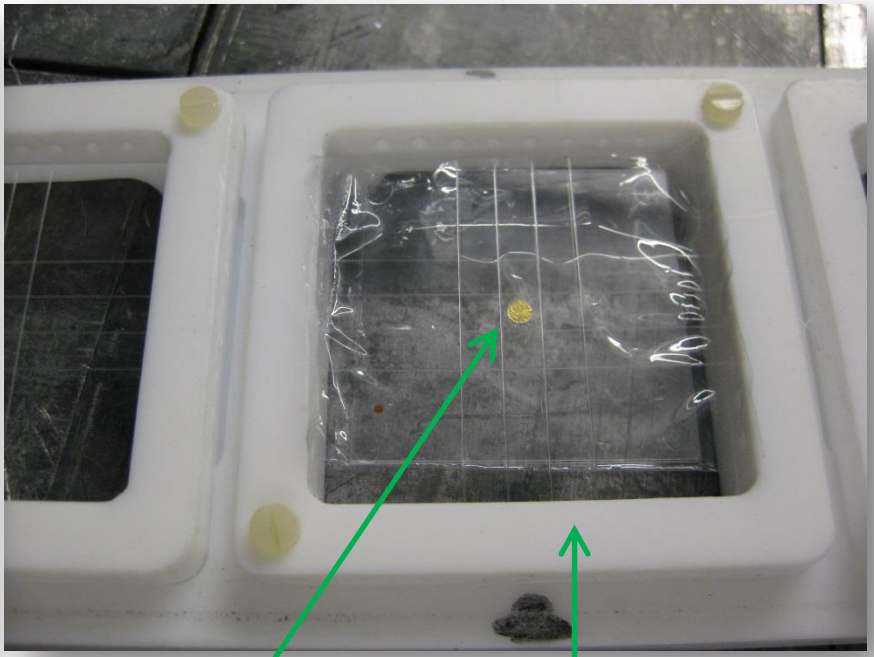
$\phi_n \approx 2.5 \cdot 10^{10} \frac{n}{cm^2 s}$

Cold neutron beam

Sample

Measurement

Samples are placed at an angle of 45° with the neutron beam in the sample chamber in front of the detector.



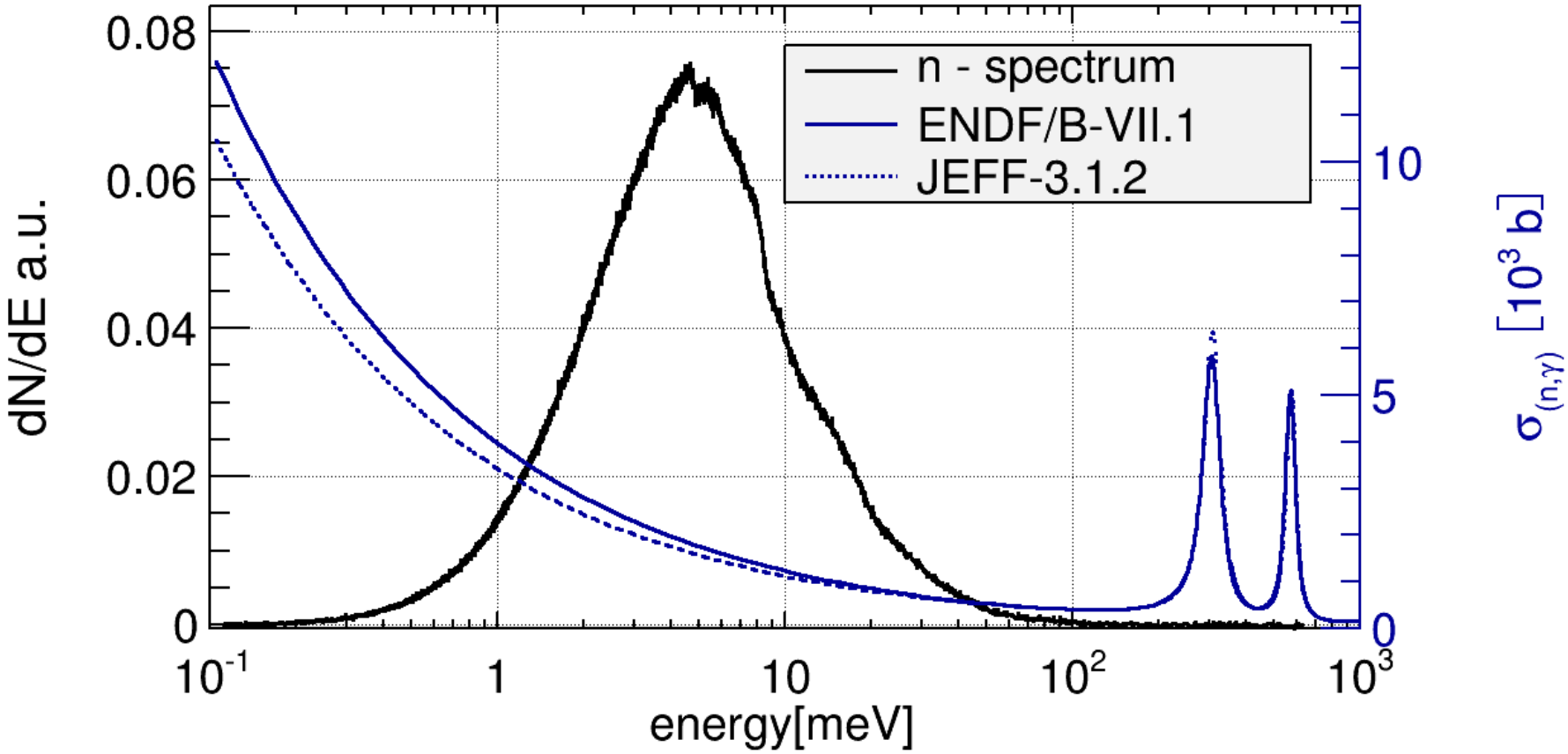
Detector

Opening of Samplechamber

^{241}Am Sample

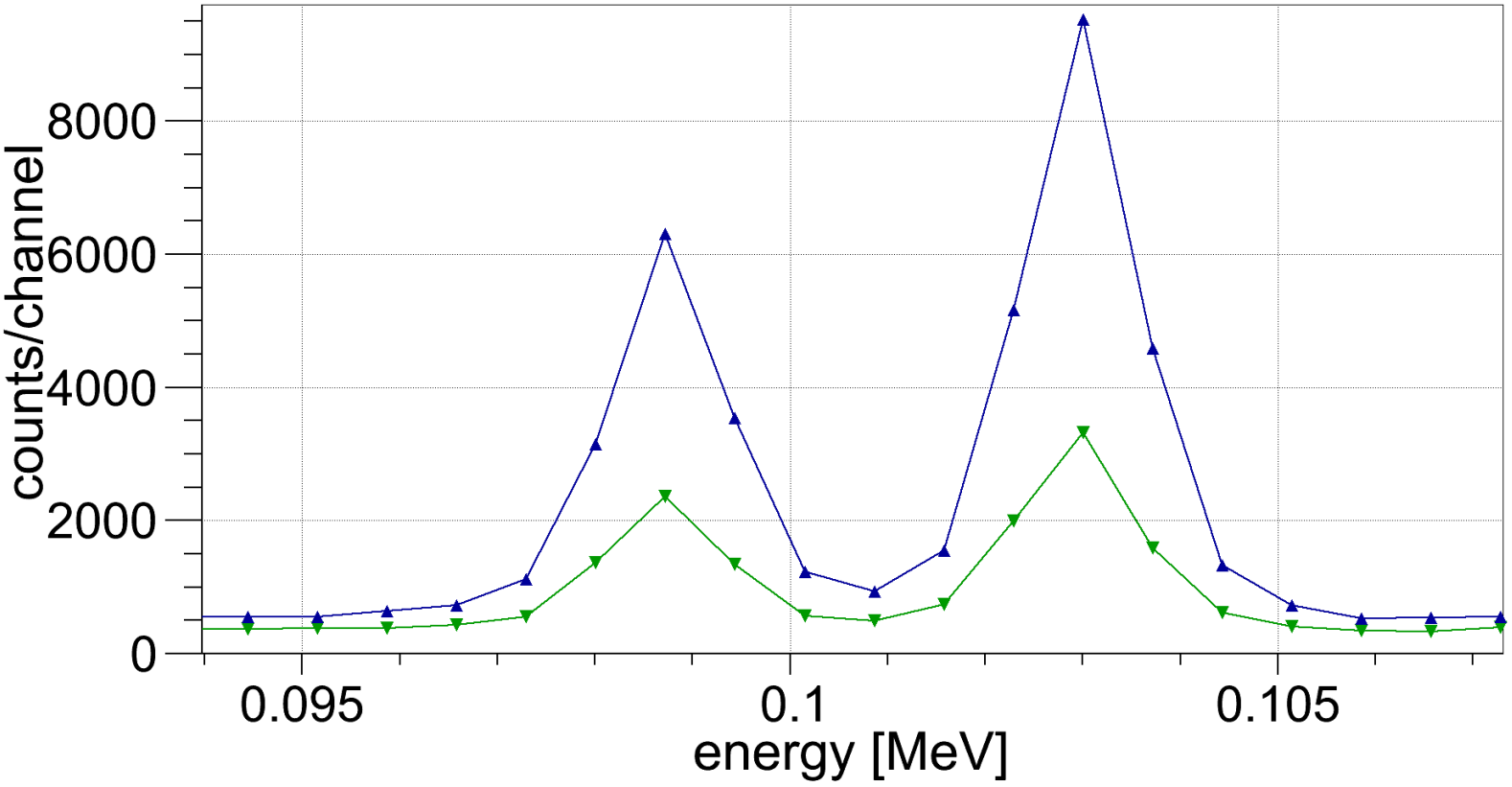
Teflon© Sampleholder

Spectra Comparision



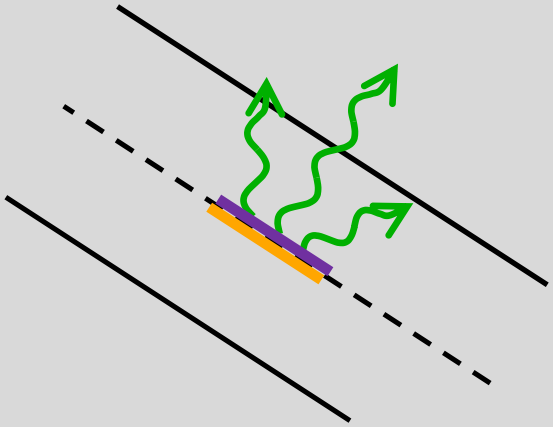
Resonance region is avoided with the cold neutron beams

Thermal Capture Cross Section of ^{241}Am



Thermal cross sections calculated using the ^{242}Pu X-Ray emission at 99 and 103 keV after ^{242g}Am decay to ^{242}Pu

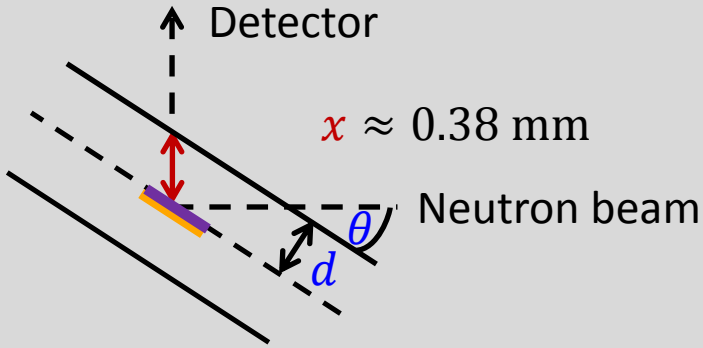
Evaluation of ^{237}Np Peaks



- Correct peak areas for the
- absorbtion in the Quartz;
- Calculate neutron flux with decay measurement of gold foil.

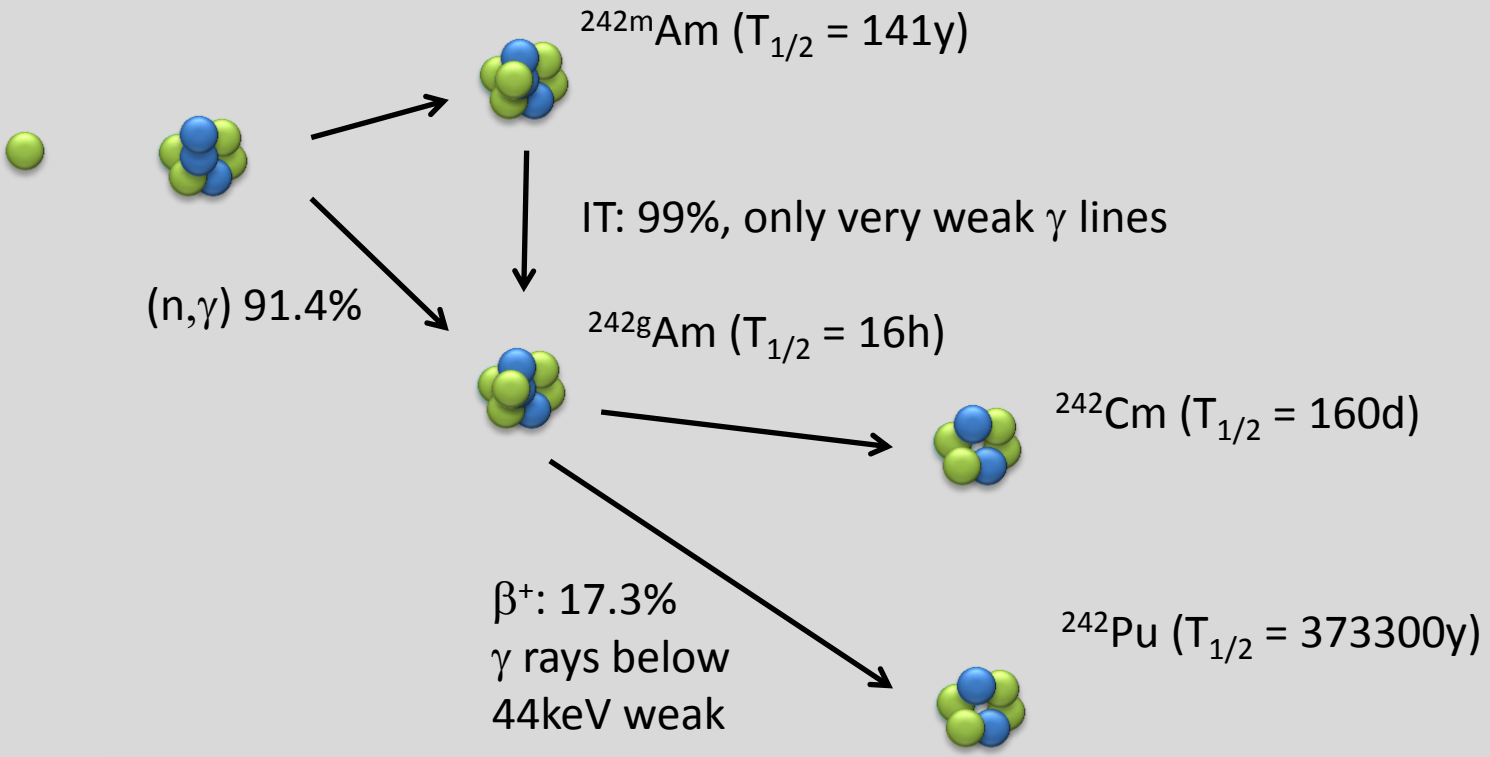
Correction via Lambert-Beer law:

$$\frac{P_c}{P_m} = \kappa_{abs} = e^{\mu_{Al}(E_\gamma)x}$$



Effect	
Absorbtion in glass	1,4%
Neutronshielding gold	0.2%

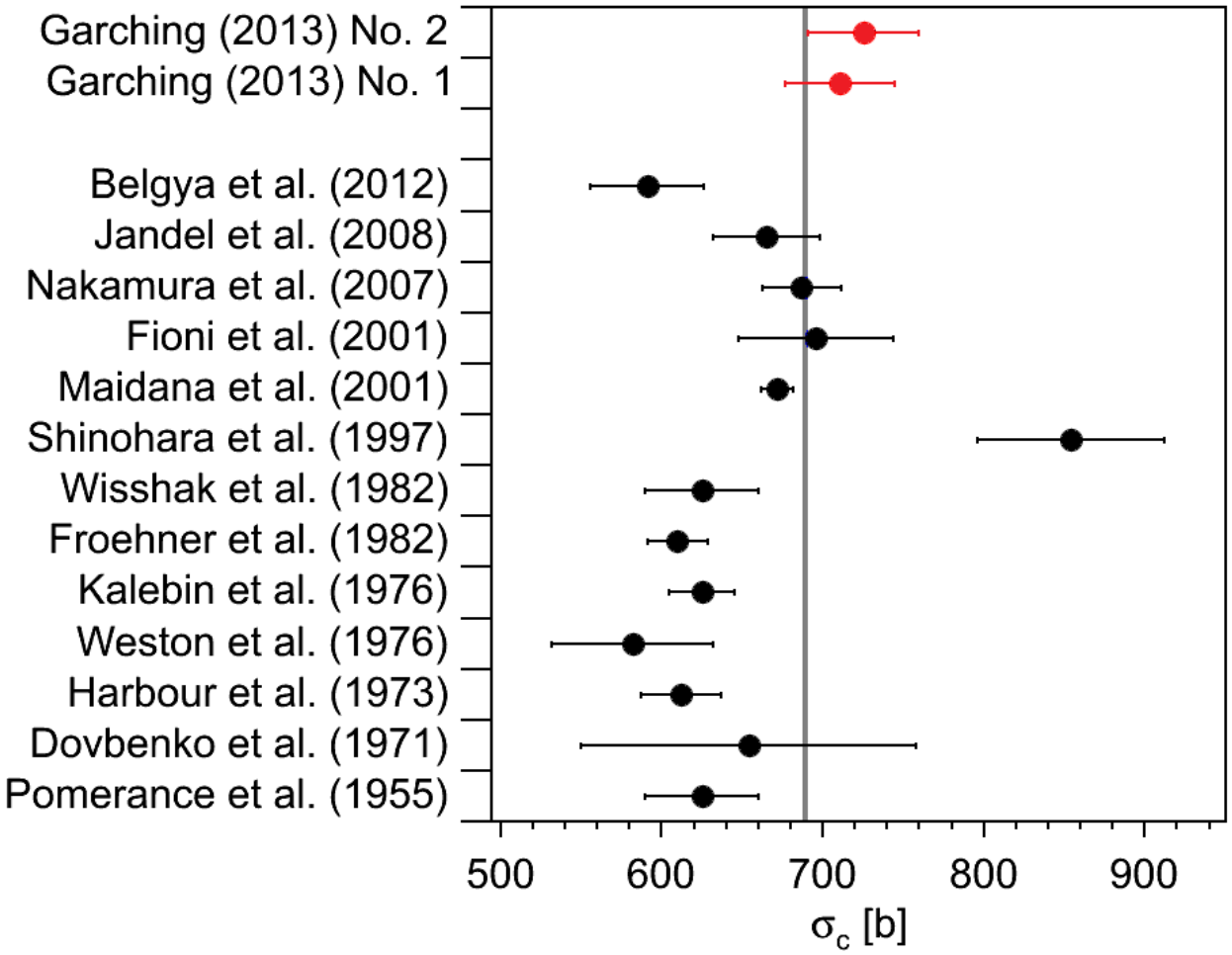
Why ^{242}Pu x-rays?



	Per decay
99 keV	0.0355 ± 0.0017
103 keV	0.056 ± 0.003

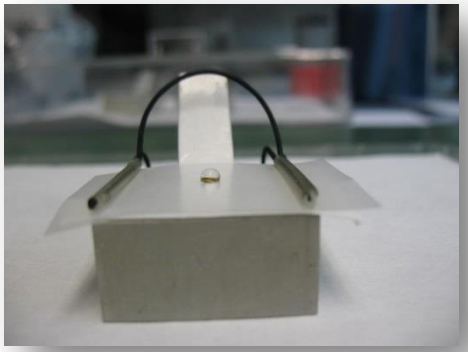
X-ray K_α after annihilation of e^+ and e^- in ^{242}Pu shell

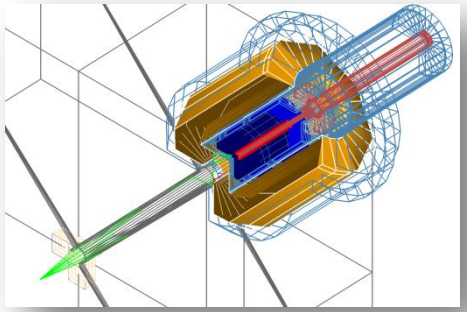
Thermal Capture Cross Section of ^{241}Am

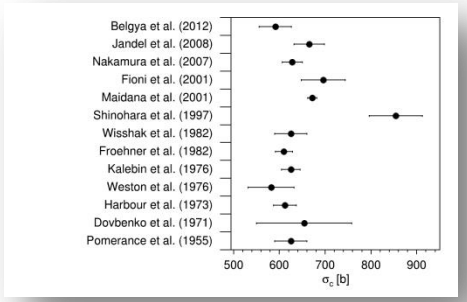


Thermal cross sections calculated to 725.4 ± 34.4 b and 711.1 ± 28.2 b

Conclusion & Outlook







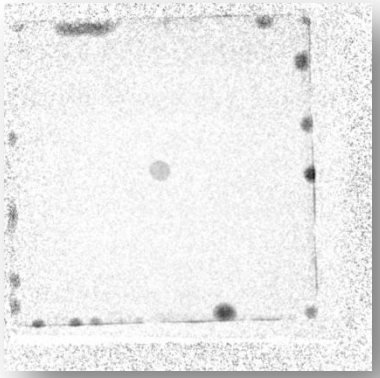
Conclusion:

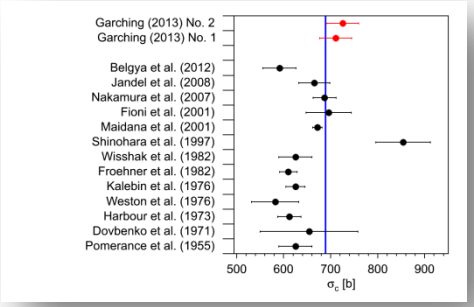
- Thermal capture cross sections have been calculated.

Outlook:

- How could the differences to other measurements be explained?

Acknowledgement





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- Petra Kudjejova

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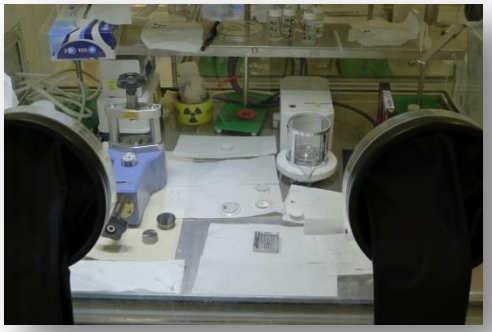
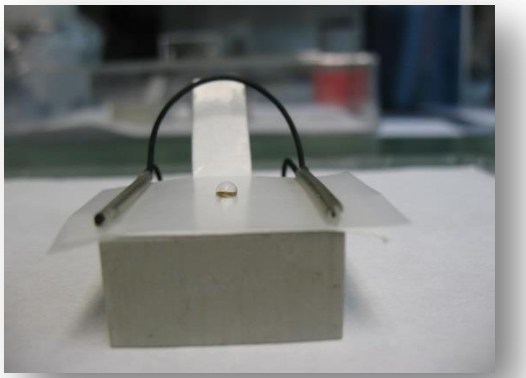
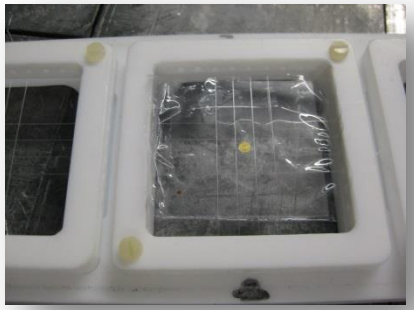
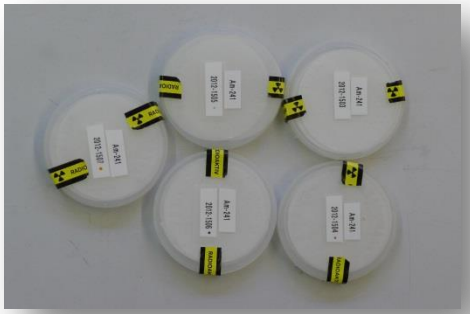
- Ralf König

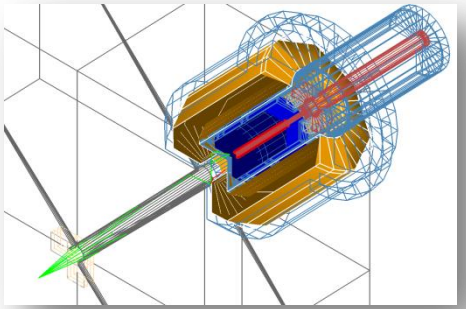




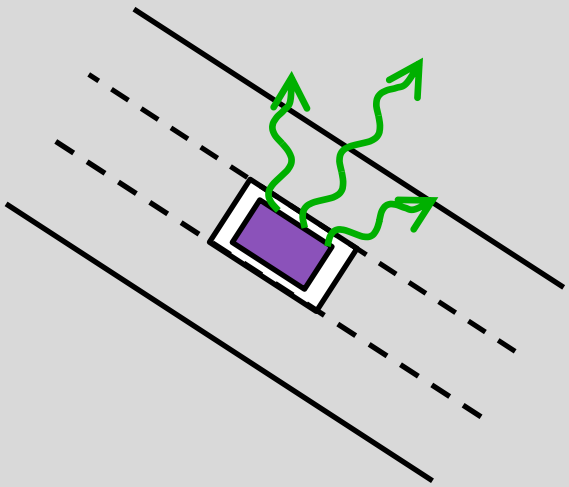
Thank you for your attention!







Evaluation of X-Ray Peaks



- Correct peak areas for the
- attenuation in the quartz.
- 241Am side of the sample was
- turned to the detector for
- Measurement.

1

Correction factor:

$$\kappa_{sc}(E_\gamma) = \frac{P_r}{P_c}$$

Real peakarea without self-attenuation

Peakarea with self-attenuation

Energy [keV]	κ_{sc}
49.47	1.27
182.84	1.05
5352.03	1.00